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SOME ASPECTS OF FOREST BIOLOGY[1]

By Professor A. W. BORTHWICK

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IN forestry the long period which must elapse between the establishment of a crop and its final harvesting at maturity makes it imperative that we should use every endeavor to secure the best types of trees suitable for the concrete conditions of the localities in which they are to be grown. If a wrong species is chosen at the start—that is, a species unsuited to the soil or climate—and in mixed woods, if a wrong combination of species is adopted in their formation, then no amount of skill, care and attention on the part of the forester can remedy the defect or make full use of the productivity or growth factors of the locality. In cultivating his crops the forester must always keep in mind that the ultimate success of his efforts is determined by rate of growth combined with the usefulness and volume of the timber produced. This again brings him into close contact with the botanist. Among species of trees, apart from varieties and sports or mutations, no two individuals are absolutely identical, in spite of all outward resemblance. There are differences in rate of growth; commencement and duration and finish up of seasonal vegetation; flower, fruit and seed production. All these may vary in time from a few days up to as much as one or two weeks. These differences may occur in all soils and in all climates. In both the artificial and the primeval forest it can be detected among trees of the same species, growing side by side on the same soil and sprung from seed of the same parent tree. Individuals from the same seed may show differences in stem quality, branch formation and crown balance, due to some internal

[1] From the address of the president of the Section of Botany, British Association for the Advancement of Science, Aberdeen, 1934.

impulse, which is independent of soil or climate. Some individuals produce straight cylindrical stems, others bent, twisted and crooked stems; some have an inherent tendency to fork and produce double leaders —accident to the end bud of a leading shoot may cause double leaders, but that is a different thing; in some the branches ascend at an acute angle, in others they tend to spread horizontally at right angles. Forking leaders and spreading branches result in defective crown formation.

Another individual defect is the tendency to produce water shoots or epicormic twigs. Unfortunately this individuality does not seem to be hereditary, otherwise we could with greater certainty avoid such in selecting our growing stocks, but even if this were possible we would still have to face the fact that defect in stem, branch and crown and rate of growth is not due to individuality alone. Although the characteristic individuality remains constant throughout the life of each single tree, it does not follow that its seedlings will all possess the same characteristics: each seedling will have inherited an individuality, but not necessarily the same as that of the parent tree. Nevertheless, rate of growth and tendency to late or early vegetation become apparent early in the life of the seedling. It is then that the first choice can be made in the selection of growing stock. But no matter how perfect the young tree may be, it is still subject to the influence of external growth factors, and climate, soil and silvicultural treatment can influence its form and growth. A plant with individual tendency to slow growth in the colder limits of its distribution will be stimulated to more rapid growth in the warmer climate; and, on the other hand, a rapid-growing individual of the warmer climate, if transferred to the colder climate, will suffer check to its rate of growth, and individuals of normal growth will show the same tendency. Keeping these facts in mind, it is easy to see how readily false conclusions may be drawn in regard to the actual and relative rate of growth of different species.

In a community of trees of different species growing on the same soil and in the same climate, some may be in their optimum, while others may be on the colder or warmer limits of their natural habitats, and the soil may suit some species better than others. If such an experimental plot were established by planting, allowance would have to be made for the time taken by different species to get over the check stage and to become completely established in their new quarters. Some species are quicker to reestablish themselves than others. That is, they are more easy to transplant. Then again, trees are not uniform in their rate of growth at all ages. We must, therefore, be careful in coming to conclusions regarding the growth behavior of trees. We must seek the aid of plant physiology and plant geography if we wish to arrive at reliable and useful conclusions. Climate is after all the main controlling factor, and each country must collect its own data. Hitherto, in forestry, we have had to rely too much on data applicable to the continent of Europe. But with a well-selected series of representative sample plots established throughout Britain by the Forestry Commission, the arrears of our knowledge in this respect are being made good rapidly.

Let us now consider the importance of these fundamental biological facts to silviculture. For convenience let us divide the life of the forest into three stages—the juvenile stage, the pole or stage of most rapid height growth, and the adult or tree stage; and, in order not to obscure the main points by unnecessary detail, let us assume that the trees have been artificially planted. In all recent plantations there is bound to be competition by weed and grass growth; it may be also woody scrub, stool shoots or interloping and unwanted light-seeded invaders. Cleaning and weeding must not be delayed. Careful tending of the young trees should begin early. Too often plantations are left to look after themselves until they are supposed to have arrived at the thinning stage, when they may yield something in the way of returns for the cost of thinning. But by this time irreparable damage may have been already done to the growing crops. Not only is weeding and cleaning necessary during this period, but now is the time to remove and replace trees of inferior growth habit, which they begin to show at this early stage. Trees which naturally tend to fork can not be improved by pruning off one of the leaders: forking will be repeated later on, as this natural individual tendency persists throughout the life of the tree. The same thing applies to all trees with faulty stem and crown formation.

Among all species, but more especially among broad-leaved trees and in particular the beech, it is these heavy-branched, spreading-crowned, short-stemmed trees which may forge ahead and become predominant in the mature stand, at the cost, it may be, of smaller but better-formed and more valuable trees. Therefore by the timely removal of such individuals, so-called wolf trees, much future trouble, cost and loss will be avoided. A certain amount of thinning may be advisable before the pole stage is reached, but such operations should be confined to completely suppressed, back-going and dead trees and aggressive, malformed wolf trees. For various species under average conditions the period of the pole stage falls between the twentieth and the fortieth year. This

should be the time of greatest density in the life of the stand. The trees have reached the stage of their most rapid annual growth in height, and this is further stimulated by the density of the stand, which also leads to lateral branch suppression and the cleaning of the stems. The density must not be too great, otherwise the trees are liable to become too long and attenuated to carry their own weight. It is here the skill of the forester is put to the test. Now is the time, and indeed the best opportunity, during the whole life of the stand to encourage length, form and cleanness of stem. Growth in height is dependent upon crown room and light; and cleanness of stem is dependent upon crown density and shade. These two opposing conditions must be so balanced that the one will not defeat the object of the other. The thinnings during this period will depend upon the planting distance originally adopted and the amount of care and attention which has been given to the young growth until the branches meet and establish cover or canopy when the thickest stage is reached. The maintenance of pole stage density is prolonged until the side branches have been killed off, by side shade, up to the desired height on the stem. Subsequent drying, decay and fall is merely a matter of time. Up to this stage, which will occupy as a general rule the first half of the rotation, the main endeavor is to secure a good growing stock of tall, straight, clean-stemmed trees.

In the second half of the rotation, which we have called the tree stage or adult stage, the problem in tending should resolve itself into obtaining the greatest volume production and quality of timber by encouragement and control of diameter increment. The quality of timber depends to a large extent upon uniformity in breadth of the year rings and the texture and fiber of the wood. This can only be obtained if the growth of the tree itself is uniform and sustained. Hence in this latter half of the rotation attention must be directed to the crowns and roots of the trees. A gradual removal of certain trees and opening up of the canopy gives the crowns of the remaining trees more light and room to expand, and this means increased food production. These cuttings may be called "light increment cuttings," in contradistinction to "thinnings," from which they differ in regard to their influence on the biology of the stand. The more open growth under light increment treatment means fewer trees at maturity, say 160 per acre, but individually they are of greater volume and collectively of not less volume than would have been produced by a larger number of trees in closely crowded crown competition. The more open stand necessitates the retention of some kind of undergrowth or, more commonly, underplanting for soil cover and preservation. This method has been successfully practised in Denmark in the case of beech, oak, pine and spruce. Under the old system of dense canopy preservation, the intermediate yield in thinnings was about 25 per cent. of the final yield. Under the light increment treatment the thinnings may amount to 20 per cent. and the light increment cuttings to 50 per cent. of the final yield. That means in the latter case we have 75 per cent. against 25 per cent. in the former; and if we assume, as we are entitled to, that the value of the material removed in light increment cuttings is greater per unit of measurement than that of thinnings, and at the same time if we keep in mind the fact that the volume of the final yield is the same in both cases, with the balance in favor of quality in the case of light increment treatment, it will be seen that the treatment increases the yield per acre by well over 50 per cent. The material removed by the light increment cuttings, from the fiftieth year onwards, would be clean grown and straight, and would yield all sizes required for telegraph poles, for which the demand has always been high. The trees of the final crop would easily be of sleeper size—that is the most all-round useful and valuable size for mature timber. If this can be done in Denmark, why should it not be possible in our equally favorable if not more favorable climatic and soil conditions?

All the problems which arise in regard to the care and treatment of young, middle-aged and maturing stands of trees are subjects of the study of stand biology, and that system of silviculture which makes the fullest use of the external factors of growth, in combination and individually, will achieve the best results in the end. The old system of preserving dense, uniform, unbroken canopy was unnatural and made it impossible to utilize to its full advantage the important growth factor, light.

In the primeval forest, loss and replacement is constantly going on. As each veteran disappears it is replaced by hundreds of seedlings which strive and struggle among themselves and against surrounding hindrances to reach the light. The struggle is a prolonged one, and many seedlings and saplings are killed off in the process. Still, nature works cheaply if slowly, and if we can make use of the free gift she offers in the way of natural regeneration, it would be an obvious gain. Nature has produced and maintains the forest for her own purposes. On the other hand, man exploits the forest for his comfort and well-being, but if he oversteps certain limits in his treatment of the forest for the sake of extra gain or profit to himself, nature revolts, with the result that man defeats his own ends.

If we are to make use of nature's free gifts, in the

natural regeneration of the forest, we must study the natural biological laws under which the process can take place. As we have seen, nature works slowly but surely in her conservation of the primeval forest, irrespective of what the utility and value of the species may be to man. Man's idea is to grow certain species only in massed, even-aged assemblages, in order to obtain the maximum amount of timber of the kind, size and quality he wants, and if he expects nature to help in the quick and certain regeneration of these artificial woods, at the end of what he considers the most advantageous age or rotation, he must make certain provisions in accordance with natural laws. This can be done by appropriate silvicultural treatment. The trees must be of a suitable seed-producing age, the forest floor must be in a suitable condition for the reception and germination of the seed, and the conditions of light, moisture and temperature must be suitable for the future growth and development of the seedlings. These three things are of fundamental importance. In most of the mature and maturing woods which have been treated under the strict artificial rules of so-called forest management, the question of quick and certain natural regeneration often presents insurmountable difficulties.

At the time required by the working plan the trees may not be in a suitable condition for flowering and seeding; the forest floor, under light demanders, may be long past the best conditions for the reception and germination of seed, owing to weed growth, and under shade bearers an over-abundance of humus, especially raw humus, is equally unfavorable. Many years are required to bring the trees and the forest floor into a suitable condition for natural regeneration, and if this is attempted over a whole compartment simultaneously, the result is seldom satisfactory. In dense-canopied, even-aged stands a series of preliminary fellings, called preparatory fellings, must be gradually carried out to allow more light and room for the selected seed trees, in as even distribution throughout the stand as possible, and also gradually to prepare those trees for their more isolated conditions and resistance to wind. Under shade bearers this opening up of the canopy leads to the disintegration of over-abundant humus by allowing more direct access of precipitations and light, and also by increased aeration due to the freer circulation of the air. Under light demanders it means costly artificial surface and soil preparation. In either case, when the soil is in its most suitable condition a further felling is made either immediately before or during a seed year, if one should happen to occur at the right time; if not, it means delay and the soil gets past its best condition for seed germination. Even if a seed year should occur at the right time, there are many climatic and weather conditions which may prevent complete and uniform regeneration over the whole area: only patches of seedlings may occur here and there. This means waiting for a second seed year, which may be five or ten years hence, meantime further deterioration in soil conditions and risk of storm damage to the seed trees which were isolated so late in life.

The only alternative in such cases is to complete the process by clear cutting and artificial planting, and this is what generally occurs. If, as sometimes happens, by good luck the regeneration is sufficiently complete to provide a new crop, then the old trees are gradually removed in a series of falls, called the final feelings. But the whole process known as the uniform or compartmental system is slow, uncertain and risky. To lessen the risks of failure and loss by opening up large areas at one time, numerous modifications have been introduced into the practise of forestry. The underlying idea was to confine natural regeneration to smaller areas, in the shape of groups or strips, with peripheral extensions of these as they became regenerated. By selecting the shape, breadth, line and direction and sequence in time of the strips, a considerable amount of success has been achieved. Strips or groups may be clear felled or a certain number of trees may be left to provide seed and to protect the young seedlings. In the former case, protection is supplied by the adjacent stand of mature trees, and seeding takes place from the side. Various and numerous combinations of the uniform, group and strip methods have been tried, with more or less success, under certain favorable locality conditions.

The main trouble is that in the past the woods have not been managed with a view to natural regeneration; under light increment treatment, the more open canopy and crown room enables the trees to respond almost immediately to the influence of the seed felling. The under planting which has kept the soil in a favorable condition for seed reception can be dealt with easily, and after the seedlings have appeared, the old trees may be removed at one felling instead of gradual removal over a protracted series of years, as a certain amount of undergrowth can be left to provide shelter and protection to the young trees.

The biology of the large pure stands of timber must obviously differ from that of large mixed stands, consisting of two or more species, as generally prevail in the primeval forest. To establish artificially or to regenerate naturally a mixed stand of timber which will have the desired ratio of species at maturity involves much labor and cost, and the attempt is not always certain of success, except perhaps under the selection method of treatment. To get over the difficulties associated with single stem mixture, other

forms have been tried, such as planting the different species in alternate rows, bands, strips, clumps and groups, but still this does not quite solve the problem. It is all right for the trees in the center of the group or strip, but those on either side at the contact margins are apt to become bent and branchy; further, each of these numerous units requires individual attention, and this is not compatible with economic management. It is possible with certain light-demanding and shade-bearing trees to form mixtures in which the crowns of the light demanders form a kind of upper story, with those of the shade bearers beneath; but such mixtures are very difficult to bring through the pole stage of growth unless the light demander happens to find itself in its optimum conditions.

The problem may now be stated: How are we to manage and develop our woods so that the demands for different species of timber, sorts and sizes of the highest quality possible, may be met, and adequate provision made for the regeneration of these woods, without loss of time and without deterioration to the productive capacity of the soil, and at the same time make as full use as possible of all growth factors, without interfering too much with the natural laws of forest growth? This is a big and important question, and in my humble opinion the solution suggested by Professor Heinrich Mayr, of Munich, seems to fulfil all these requirements. His suggestion was to compromise between the economic objects of man, the user, and the natural laws which govern the designs of nature, the producer. He suggested that the forest should be made up of small compartments, 1 to 8 acres, each compartment to consist of one species. These small pure compartments would be scattered as much as possible, so that adjacent compartments would differ in age and species. We would thus have a forest of mixed small compartments differing in age and species. Due attention would be given to assigning each species to its most suitable soil and exposure. Where conditions were such that only one species would grow satisfactorily, owing to physiographical conditions, such as in the mountains, pure sand, wet soils, cold climate, the compartments may be larger, about 14 acres, if desired, and the same species may adjoin each other, but the age difference between adjoining compartments should be varied.

The present division of the forest into large compartments need not be done away with, but each large compartment should be subdivided into sub-compartments—small compartments—which would become permanent units of management. Each small compartment treated from its earliest stages with a view to natural regeneration would, under later light increment treatment, always be in such a condition that natural regeneration could be imitated without long and costly preparation. The process could be completed within five years, and the risks of failure would be small compared with those of large contiguous areas, where ecological and biological conditions vary. In the small stand, the more open stand of the trees under the light increment treatment and the shelter afforded by adjacent stands would eliminate the necessity of the risky and lengthy preparatory fellings—a seedling felling and one final felling would suffice. Thus, as Professor Mayr claims, natural regeneration could be made easier, speedier and safer. The danger and risks from wind, fire, insect and fungus epidemics would be lessened; the varied demands for different kinds, sorts and sizes of timber could be more easily met. The forest community as a whole would approximate that of the primeval or natural forest, and the productivity of the soil would at least be preserved, if not improved.

To turn now to another aspect of the forest as a living community of plants and animals. The forest is perennial and less subject to seasonal changes than other forms of massed vegetation. The tree stems raise their crowns of branches, twigs and leafy canopy high above the forest floor, and this has a marked influence on the light, temperature and moisture conditions within the forest. Light is subdued, but temperature and moisture are both increased, and this, combined with a relatively still atmosphere, render the conditions within and under the crowns of the trees quite different from those of open country. Under the leafy canopy the soil surface vegetation consists mainly of shade-loving shrubs, herbs, ferns and mosses. The leaf fall from the trees and the general organic remains, along with that of the undergrowth, produce a soil covering of disintegrating organic matter, generally referred to as the humus layer. This layer acts like a mulch and ameliorates and conserves soil moisture and temperature. The tree roots penetrate more deeply into the substratum than most forms of other vegetation, this increasing its aeration, permeability and water-holding capacity. Although it has not been definitely decided whether forests increase the rainfall or not, it can be claimed with every justification that the forest is of great importance as a conservator of water and as an equalizer in the drainage of the land. Where no forests exist in the upland or collecting regions of watersheds, the rain falls unhindered, beating the surface hard or eroding it down to the bare rock. There is nothing to check the downward rush of water, which collects into mountain torrents which gush unbridled into the main rivers and streams, causing them to become swollen and flooded. These in turn race through the fertile valleys to their outlets, tearing

down and overflowing their banks. The damage done by severe and sudden floods to roads, bridges, agricultural crops and stock, including human habitations, is well-nigh incalculable. Nor does the matter end there: millions of tons of valuable soil are washed away in these turbulent floods, and deposited as barriers in the river beds or in the sea at the river bar. Harbors and docks at the outlet of our main rivers become silted up with mud and debris: this in turn—apart from the loss of soil—involves costly dredging operations to keep the navigation channels clear.

Where forest exists in the upland districts or collecting ground of the water, rivers are more uniform in their flow, year in year out, and carry much less silt and debris. The crowns of the trees break the force of the falling rain; the humus layer on the forest floor has an enormous water-absorbing capacity, and when saturated it allows the water to percolate slowly into the deeper loosened layers of mineral soil, from which in turn it gradually finds its way into springs and watercourses. Further, the influence of the forest is such that the melting of snow is more gradual and water is slowly absorbed and held, thus again avoiding floods. The forest regulates the offflow of water after heavy rains or melting snow. This water is fed into springs and watercourses more gradually throughout the year, thus preventing floods at one season and equally serious drought at another. As regards the influence of the forest in lessening the destructive effects of cloudbursts, we have it on the authority of Fernow that: "The forest litter, the moss-covered leaf-strewn ground, is capable of absorbing water at the rate of 40,000,000 to 50,000,000 cubic feet per square mile in 10 minutes, water whose progress is delayed by some 12–15 hours after the first effects of a heavy freshet have passed." I do not claim that afforestation or forest conservation in the high ground and valley slopes will entirely prevent floods and drought, but what the forester is doing or leaves undone in the remote hinterland will go a long way to check or ameliorate the evil effects of both. I have referred to these facts because the biological influence of the forest is so important and wide-spread in regard to drainage and water supplies.

As a form of vegetation which rises high above the surface of the ground, the value of the forest in breaking and tempering the effects of the cold winds has long been recognized and appreciated by the agriculturist. An adjacent sheltering strip or even clump of trees exercises a marked influence on farm crops and pasture lands; stock also thrive better in the shelter afforded. The trees afford shelter and at the same time exercise a very marked influence on the rate of evaporation of moisture from the surrounding area; this influence, in lessening the surface velocity of the wind and rendering it more moist, may be noted up to between 300 and 400 feet from the trees, but the distance varies with the height of the trees. In spring the pasture is earlier and more abundant, while in the autumn it remains longer green. The question of a reasonable balance between forest and grazing land is one of considerable biological and economic importance.

In the time available it is obviously only possible to refer to a few aspects of forest biology. I would have liked to say more about the importance of plant geography, but probably enough has been said to indicate how important this branch of botany is to forestry. Plant physiology and ecology are also of the highest service in the applied science of forestry. Plant anatomy is likewise of great value in wood technology, timber identification, seasoning, testing and preservation, which are all very materially helped by a knowledge of wood anatomy. It is needless to say that without help of the botanical systematist the forester would frequently find himself in serious difficulties, while the mycologist is equally indispensable.

Many biological problems of first-class importance in silviculture have still to be tackled, and it is to botany that the forester must look for their ultimate successful solution.

SCIENTIFIC EVENTS

THE TRAINING OF PHYSICIANS IN SOVIET RUSSIA

IN a special cable to *The New York Times* Walter Duranty, correspondent from Moscow, describes the training of physicians as an important feature of the Second Five-year Plan of the USSR. Mr. Duranty writes:

The plan provides for a great increase in the number of medical students. In 1928, at the beginning of the First Five-Year Plan, the total number of students was 26,000. On January 1 of this year it was 48,000. The plan provides for the admission of 15,000 additional students this year—beginning this month—24,000 more next year, 30,000 in 1936 and 33,000 in 1937.

Whereas 5,400,000,000 rubles was spent on the hygienic needs of the Soviet Union—which include rest homes and physical culture as well as hospitals, medical schools and the like—the Second Five-Year Plan's hygienic budget amounts to 19,600,000,000 rubles. The number of hospitals in the cities will be increased by 44 per cent. and in the rural districts by 98 per cent.

The Bolsheviki assert there is no branch of the na-

tional life where a central socialized government has such a value as in organizing public health. They admit Russia's backwardness in this respect, but they believe that with the help of the state's resources medicine can be developed rapidly to a degree that no individualist system will be able to equal.

Two such eminent public health authorities as John A. Kingsbury, of the Milbank Memorial Fund of New York, and Sir Arthur Newsholme, who was long the chief public health officer of Great Britain, told the writer after they had taken trips through Russia two years ago that the foundations for a public health service were being laid on a scale that no other country had yet contemplated.

Medical students in the Soviet Union by the end of the Second Five-Year Plan will number more than 100,000. Their five years' training expenses, including food and lodging, will be wholly paid for by the state. But there will be no more hurried granting of medical degrees, which produced "qualified physicians" after a two-and-a-half years' correspondence course.

Even that was better than it sounds. True, the said physicians had no higher real qualifications than the average American trained nurse, but the dearth of any kind of medical knowledge was so great here that even a half-qualified doctor was better than nothing. There are still villages in European Russia where the village priest and sorcerer vie in treating the sick.

Henceforth there will be an obligatory five-year training period, with entrance examinations to test the candidates' fitness and half-yearly examinations by a special state board, wholly independent of the hospital or school where the students are being trained, to insure that they are making progress.

The training program provides that 75 per cent. of the students shall become what one might call general practitioners, while the remainder, selected by examination, will be educated as specialists.

Medicine will probably predominate over surgery because the Russian Health Commissariat, which controls the medical profession, has been "sold" on the idea of preventive rather than curative treatment. In this connection the program provides a great extension of children's doctors, and it is interesting to note that 74 per cent. of the present-day medical students are women.

The new program further requires that doctors in villages or small towns must take a course not less than once every three years in an urban medical school or hospital to keep themselves up to date. For this their traveling and living expenses are paid, plus the full salary they have been receiving in their own post.

As this indicates, it is the intention of the authorities to eliminate private practise as far as possible. Their idea is that doctors should become salaried officials of the Health Commissariat, as is already generally the case in Moscow.

But even here, and to a considerable extent in other cities, private practise continues, and some physicians earn a great deal of money, but it is expected that this will be superseded before the end of the Second Five-Year Plan by a system in which every citizen through his "social insurance" will receive free medical treatment.

RUBBER PLANT EXPERIMENTS

EXPERIMENTS by the U. S. Department of Agriculture, covering practically every important plant used for commercial production of rubber throughout the world, have singled out as the most promising sources for domestic rubber: goldenrod; guayule, a shrub which grows well in the Southwest; and Hevea, the rubber tree of the tropics. Of these, goldenrod is regarded as the most likely to develop commercially. The recent transfer to the department of the Edison collection of goldenrod selections has given new impetus to the research program.

Rubber of good quality has been made from goldenrod, but the details of extraction and manufacture have not been developed sufficiently to produce rubber on a commercial scale. With present knowledge it would not be possible to make rubber from goldenrod at prevailing prices of about 15 cents a pound. However, the experiments now in progress lay the foundation for domestic rubber production in case of an emergency.

Guayule is a shrub native to Mexico and southern Texas which resembles sage brush and which can be harvested with machinery. Several thousand acres have been planted to guayule in California by a company interested in its development. For maximum yields, guayule is harvested only every fourth year, thus it would be necessary for farmers to have some assurance of a stabilized price before this crop could be grown on a large scale. Because the whole plant is harvested it is necessary to have a large area and a succession of plantings to insure a continuous harvest. It is a long-time, large-scale rotation.

Other sources of rubber which could be developed in this country if the price were high enough to warrant it include the Hevea, the rubber tree of the tropics. The department now has 30,000 of these trees growing in Florida, some of them from seed produced there. There is said to be reason to believe that the yield will equal that of the East Indies.

Rubber made from guayule and goldenrod in this country so far has not been so good as the imported product. In the opinion of L. G. Polhamus, who for several years has been engaged in a study of rubber plants for the Department of Agriculture, with continued improvement in methods of extraction, it is possible that domestic rubber from these plants might be made to approximate that from the East Indies.

So far, *Solidago leavenworthii,* one of the Edison selections, has the highest rubber content of any of the goldenrods analyzed. Specimens have produced more than 12 per cent. rubber. Another species, *S. fistulosa,* has analyzed as high as 9 per cent. rubber. A third species which yields from 4 to 6 per cent. rubber is considered promising because of its greater leaf production. The goldenrod experiments have not,

however, progressed far enough to warrant any one going into the business of growing or collecting goldenrod.

In experimenting with goldenrod many problems have arisen, which appear in almost every case when a plant is domesticated. Insect and fungous enemies may do little damage when the plant is wild, but once it is concentrated in cultivation these attacks become serious. Several root, stem and leaf diseases have been found in goldenrod plantings in Florida and South Carolina. Leaf diseases are especially disastrous because rubber is formed increasingly in the leaves as they mature, and it is necessary that they remain on the plant as long as possible.

Because of the uncertainty of reproducing desirable strains of goldenrod by seed, vegetative methods have been used. The underground stolons, which are produced freely, propagate readily. As many as five hundred new plants have been grown in a single year from the stolons of a single plant of *Solidago leavenworthii,* growing at Fort Myers, Florida. Plants grown from stolons produce a crop of rubber the first year.

There are two general processes for extracting rubber from plants. With the mechanical method, used with guayule in Mexico and California, the plants are ground up and macerated in a pebble mill. The rubber gathers into small lumps which can be separated from the powdered woody material by flotation in water. The other method is to dissolve the rubber out of the plants by chemical solvents. This is the method best adapted for use with goldenrod.

CONFERENCE ON THE BIOLOGY OF SEX

A CONFERENCE on the biology of sex was held from August 25 to 30 at the Marine Biological Laboratory at Woods Hole under the auspices of the Committee for Research in Problems of Sex of the National Research Council. The committee has been active since 1921. There is one annual meeting and from two to five other meetings a year as necessary.

Various aspects of the work of the committee and of cooperating investigators were discussed under the following subdivisions of the general topic:

"The Status of Work in the General Biology of Sex" by Frank R. Lillie and Carl G. Hartman.

"Endocrinological Problems of Sex" by Philip E. Smith and Charles R. Stockard.

"Neurological Problems of Sex" by Philip Bard and Karl S. Lashley.

"Psychobiological Studies of Sex" by Adolf Meyer and Calvin P. Stone.

Aspects of the physiology of sex and reproduction other than those previously considered were discussed by Edgar Allen and Frederick L. Hisaw.

Participating in the conference were the members of the committee: Francis G. Blake, Yale School of Medicine; Walter B. Cannon, Harvard Medical School; Frank R. Lillie, University of Chicago; Adolf Meyer, the Johns Hopkins Hospital; Clark Wissler, the American Museum of Natural History; Robert M. Yerkes, Yale University, and the following invited guests: Edgar Allen, Yale School of Medicine; Philip Bard, the Johns Hopkins Medical School; George W. Corner, University of Rochester; Earl T. Engle, Columbia University; Carl G. Hartman, Carnegie Institution of Washington; Frederick L. Hisaw, University of Wisconsin; Fred C. Koch, Karl S. Lashley, Carl R. Moore and William F. Ogburn, University of Chicago; Philip E. Smith, Columbia University; Charles R. Stockard, Cornell University Medical College; Calvin P. Stone, Stanford University; George B. Wislocki, Harvard Medical School; Emil Witschi, University of Iowa.

NEW YORK MEETING OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

THE Biological Photographic Association, an organization embracing modern developments in photography, met on September 13, 14 and 15 for its fourth annual convention in New York University.

The convention was held in the biological laboratories of the Washington Square College, on the site where the first photograph of a human face by the light of the sun was made by Professor John W. Draper, nearly a hundred years ago. Louis Schmidt, of the illustration division of the Rockefeller Institute for Medical Research, was chairman of the convention committee.

Two exhibits were held in conjunction with the conference, one of color photography at the university and one at the Hotel Brevoort. The Brevoort exhibit included botanical and crystalline prints submitted by Dr. Silvestre Prat, a member of the association, and his associates of Prague, Czechoslovakia.

The convention opened on Thursday with the address of the president, Ralph P. Creer, of the Edward Hines, Jr. Center, Hines, Illinois. The annual banquet was held at the Hotel Brevoort. Speakers included Mr. Schmidt, Mr. Foster and W. H. Zieler, of E. Leitz, Inc., New York City, on "Photomicrography of Living Objects"; Leonard A. Julin, of the Mayo Clinic, Rochester, Minnesota, on "Some Notes on Photography at the Mayo Clinic," and F. R. Harding, of the Children's Hospital, Boston, on "The Importance of the Human Relations of the Biological Photographer with his Chief, his Client and his Patient." On Friday there was a discussion of infra-red photography in medicine by Leo C. Massopust, of Marquette University. L. V. Foster, of the Bausch and Lomb Optical Company, Rochester, New York, spoke on "Photomicrography with Ultraviolet Light," and

Hi(eq) Williams, of New York, on "Illustrative Photography in Color," and Mr. Schmidt discussed the direction of light as the dominant factor in the photography of bacterial colonies. Other papers included C. E. Dunn, of George Murphy and Company, Inc., "A Practical Demonstration of Belcolor"; Dr. Francis Carter Wood, Institute for Cancer Research, Columbia University, "Lumiere Color Photomicrography"; Edward Mila, Metropolitan Museum of Art, "Color Subjects Rendered in Monochrome"; Heinz Rosenberger, of New York and Sandy Hook, Connecticut, "Additional Points in Cinema Technique"; C. G. Grand, Department of Biology, New York University, "Microcinematography"; Loren E. Tutell, Chicago Aquarium, "Marine Photography"; S. G. Dunton, New York Aquarium, "Some Motion Picture Technique in Aquatic Photography"; Arthur W. Fuchs, of the Medical Department, Eastman Kodak Company, "The Preparation of Illustrations for Half-tone and Line Engraving"; and one by Louis P. Flory, of the Boyce Thompson Institute.

Officers of the association are Ralph P. Creer, *president;* Louis Schmidt, *vice-president;* Anne Shiras, University of Pittsburgh, *secretary,* and Katharine W. Kingsbury, Columbia University, *treasurer.*

RECENT DEATHS AND MEMORIALS

DR. BERTHOLD LAUFER, curator of anthropology at the Field Museum of Natural History, was killed on September 13 by a fall from the eighth floor of a hotel in Chicago. Dr. Laufer, who was born in Cologne, Germany, in 1874, was distinguished for his work in Oriental anthropology. He was a member of the National Academy of Sciences.

DR. PAUL G. SHIPLEY, associate professor in pediatrics at the Johns Hopkins Medical School and assistant chief physician at the Harriet Lane Hospital, died suddenly on September 12, at the age of forty-five years.

DEATH closed on August 18 the twenty-year service to the University of Illinois of Frank Lincoln Stevens, professor of plant pathology. Previously, he was for a number of years professor of botany at the North Carolina State College, and for two years dean of the College of Agriculture of the University of Porto Rico. He was internationally known for his contributions in the field of tropical fungi. He held honorary degrees from the University of San Marcos, Peru, and from the University of Glasgow. In 1930–31 he occupied the Baker memorial professorship at the University of the Philippines.

The Geological Magazine reports that the corporation of the Borough of Morecambe and Heysham has placed on the house where the late Professor J. E. Marr was born in 1857 a memorial tablet, which was unveiled on June 23 by Mrs. Walker-Jones, his last surviving sister. Professor Sir F. Gowland Hopkins, president of the Royal Society, spoke on the work of Professor Marr as a geologist.

THE Paris correspondent of the *Journal* of the American Medical Association writes that "the municipal council of Paris recently gave the name of Dr. Carlos Finlay to a street of the fifteenth ward of the capital, an honor to a foreign scientist almost without precedent, Humboldt and Linné being further examples. Finlay, whose mother was French, studied in France, and on returning to his native country he announced the theory of transmission of yellow fever by mosquitoes. Last December the Academy of Medicine had celebrated the centenary of Finlay's birth at a special session attended by Professor Dominguez, who came to France to pronounce the eulogy of his compatriot."

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM WHITEHEAD WATTS, emeritus professor of geology in the Imperial College of Science and Technology, South Kensington, has been elected president of the British Association for the Advancement of Science.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, was elected president of the International Congress of Electro Radio Biology, held in Venice from September 10 to 15.

THE American Astronomical Society has awarded the first Annie Jump Cannon Prize for distinguished work in astronomy by women to Dr. Cecilia Payne Gaposchkin, of the Harvard College Observatory. The prize, which was established by Miss Cannon, consists of a cash award and some other token, the nature of which has not yet been decided.

AT the meeting of the Société Française de Photographie et de Cinematographie held on January 26, it was unanimously voted to award the silver medal of the society to Dr. Burt H. Carroll and Dr. Donald Hubbard in appreciation of their research on photographic emulsions at the National Bureau of Standards. An excerpt from the report recommending the award and appearing in the *Bulletin* of the society is as follows: "The budget retrenchments which the Government of the United States have made has forced the Bureau of Standards to close its laboratory devoted to the study of photographic emulsions, a lab-

oratory in which Messrs. Burt H. Carroll and Donald Hubbard have carried on researches the publication of which has for the first time given quantitative information on the preparation of modern photosensitive emulsions. . . . Our society will be honored in awarding to Messrs. Carroll and Hubbard two of its medals, thus expressing its appreciation of their important contributions in a field heretofore mysterious."

THE Congress of Physical Therapy awarded at the recent Philadelphia meeting its golden key to Dr. Leroy W. Hubbard, director of the Warm Springs Foundation for Infantile Paralysis Treatment, in Georgia; to Dr. Henri Brodier, professor of medicine, University of Lyons, for studies in the physiology of high frequency currents; to Dr. Oscar Bernard, of St. Moritz, Switzerland, for studies in heliotherapy in surgical tuberculosis; to Dr. Franz Nagelschmidt, London, for studies in the use of diathermy, and to Dr. W. W. Coblentz, of the Bureau of Standards, Washington, D. C., for work in the field of ultraviolet radiation.

THE *Journal* of the American Medical Association states that the infirmary building of the new Seaside Sanatorium for children at Waterford, Conn., has been named in honor of Dr. Stephen J. Maher, for twenty years chairman of the Connecticut State Tuberculosis Commission. The new sanatorium, erected at a cost of $500,000, will care for patients with bone and glandular tuberculosis and replace the old building at Crescent Beach.

DR. CHARLES F. ROOS, chief of the research and planning division of the NRA and from 1930 to 1932 permanent secretary of the American Association for the Advancement of Science, has been appointed professor of economics at Colorado College.

MAURICE JAMES, of the department of biology at the University of Colorado, has been appointed curator of the museum at the State Agricultural College, Fort Collins, Colo.

PROFESSOR G. GREY TURNER has been appointed to the university chair of surgery at the British Post-Graduate Medical School of the University of London.

THE Institute of Pathology of The Western Pennsylvania Hospital announces the following appointments to its research staff: Dr. Philip B. Hadley, until recently associate professor in bacteriology in the School of Medicine of the University of Michigan; and Dr. Arthur P. Locke, formerly associated with the department of chemistry of the University of Chicago and with St. Luke's Hospital as chief of biochemical research. The Institute of Pathology is the medical research affiliate of the Mellon Institute of Industrial Research.

ACCORDING to the *Journal* of the Washington Aca emy of Sciences, O. W. Torreson has succeeded J. I. Cairns as observer-in-charge of Huancayo Magne Observatory in Peru. The latter, having complet his three-year term of service at the observatory, w return to Washington. W. E. Scott has been a pointed observer on the staff of the observatory a has left Washington for Peru.

PROFESSOR HARLEY H. BARTLETT, chairman of t department of botany and director of the botani gardens of the University of Michigan, has been a pointed chairman of a sub-committee on administr tion and relations with other federal establishme under the general congressional committee on re ganization of the U. S. Botanic Garden in Was ington.

PROFESSOR H. H. LOVE, of the department of pla breeding at Cornell University, has returned from t Orient after a stay of three and a half years. Pr fessor Love went to China to serve as adviser in ag culture to the Ministry of Industries, to direct cro improvement work in the provinces of Kiangsu a Chekiang, and to train Chinese in this work at t University of Nanking and the National Central U versity of Nanking.

DR. R. A. MILLIKAN, of the California Institute Technology, has left Pasadena to sail for Europe attend a joint conference of the International Uni of Pure and Applied Physics and the British Phy ical Society meeting in London from October 1 to under the presidency of Dr. Millikan and of Lo Rayleigh.

DR. WILLIAM F. ZIMMERLI has been appointed delegate of the American Chemical Society to t fourteenth Congress of Industrial Chemistry to held in Paris from October 21 to 27, under the auspi of the Société de Chimie Industrielle.

DR. HENRY FAIRFIELD OSBORN, honorary life pre dent of the American Museum of Natural Histo who sailed for Europe on August 1, has returned New York.

DR. REXFORD GUY TUGWELL, Under Secretary Agriculture, has sailed for Europe to attend a me ing of the International Agricultural Institute Rome.

RAYMOND L. DITMARS, curator of reptiles at t New York Zoological Park, returned to New Yo on September 8, after spending a month in Trinid making collections of reptiles for the park.

F. K. PEASE, of Portsmouth, England, sailed fr Liverpool on August 31 for Canada, on his way the Arctic in search of log books or other relics the Franklin Expedition of ninety years ago whi

sulted in the loss of many lives, including that of ir John Franklin.

T. H. EVERETT, horticulturist of the New York otanical Garden, is spending five weeks in England, siting botanic gardens and private estates and lec- ring on the New York Botanical Garden's expedi- on into the southern Appalachians in the autumn of 33.

DR. OSCAR E. HUBBARD, for two years with the In- itute of Human Relations at Yale University, has come psychiatrist at the Fairfield State Hospital, ewtown, Conn.

J. BARTELS, research associate of the Carnegie In- itution of Washington and professor at the Först- he Hochschule, Eberswalde, Germany, will work for out three months in the Department of Terrestrial agnetism, Washington, D. C.

DR. W. EDWARDS DEMING, of the Bureau of Chem- ry and Soils, U. S. Department of Agriculture, be- n on September 27 a series of thirty weekly lec- es on the statistical theory of errors.

PROFESSOR MILO HELLMAN will deliver a course of enty-five lectures on problems confronting the thodontist at the School of Dental and Oral Sur- ry, Columbia University, beginning on October 1.

A SERIES of lectures in industrial chemistry and emical engineering will be presented by technologic ecialists of Mellon Institute of Industrial Research ring 1934–1935. These discourses, which will be livered on alternate Thursdays, in the fourth period 1:30 A.M.—12:30 P. M.), throughout both semesters, l be open to all students of industrial chemistry d chemical engineering in the University of Pitts- rgh, as well as to members of the institute. The t lecture will be given on October 4 by Dr. E. R. eidlein on "The American Institute of Chemical gineers." He will be followed by Dr. F. P. Las- er, who will speak on "Fuels for Power Genera- n"; H. B. Meller, "Air Hygiene"; S. M. Phelps, efractories"; Dr. A. P. Thompson, "Abrasives"; E. W. Reid, "Chemicals from Natural Gas and troleum"; Dr. W. B. Burnett, "Rayon"; Dr. M. H. gelow, "Synthetic Resins"; Dr. O. F. Hedenburg, secticides and Fungicides"; Dr. H. K. Salzberg, airy Products"; Dr. M. D. Coulter, "Food Mer- ndising"; Dr. Jules Labarthe, "Commodity Stand- ds"; Dr. L. H. Cretcher, "Synthetic Medicinals," Dr. G. D. Beal, "The Pharmaceutical Industry."

Two new sound pictures on the preservation of d life, combining scenic beauty with pictures of d game mammals and birds, have been released by U. S. Department of Agriculture. Paul G. Red- on, formerly chief of the Bureau of Biological Survey, delivers the lecture for "Our Wild-life Resources," a two-reel film contrasting the wild life of North America as it existed in the sixteenth century with that of to-day. It shows the methods employed by the Bureau of Biological Survey to preserve remaining species threatened with extinction. Scenic shots show birds and mammals in natural surroundings. "The Wapiti of Jackson Hole," a one-reel picture (lecture by O. J. Murie, biologist of the Bureau of Biological Survey), tells the story of the elk and their winter refuge near Jackson Hole, Wyoming. The life history of the elk is outlined, and scenes are presented illustrative of aid given to the elk herd in hard winter seasons. Prints of these films in 35 mm size, sound-on-film, may be borrowed from the Office of Motion Pictures, U. S. Department of Agriculture, Washington, D. C. No rental is charged, but the borrower pays transportation. A list of other available sound films may be obtained on application.

The British Medical Journal reports that the Achille Sclavo prize of 10,000 lire, founded by the National Opotherapeutic Institute of Pisa under the patronage of the National Institution for Research, is offered for the best essay on one of the three following subjects: (1) comparative investigations on the total endocrine extracts and their hormones in their physiological and therapeutic aspects; (2) experimental and clinical contributions to the pathology of the thymus; (3) relations between the hypophysis and somatic and metabolic activity. The first prize will consist of 8,000 lire and there will be two consolation prizes of 1,000 lire each. Two copies of the essay should be sent not later than May, 1936, to the Consiglio Nationale delle Ricerche, Ministeria della Educazione Nazionale, Viale Del Re, Rome.

A CORRESPONDENT from Rome to the London *Times* writes: "Armed with special surveying instruments from the Geodetic Institute of Padua, Senator Soler, who is professor of geodetics in the University of Padua, and Professor Boaga, of the Higher Engineering School of Pisa, have undertaken a series of experiments on Mount Vesuvius. In recent years they investigated the limestone caves in the Carso, near Trieste and Postumia, and are said to have established the probable existence of many caves as yet unexplored and new means of connection between various groups of caves. It now appears that they propose to investigate whether the central conduit of Vesuvius descends for a long distance perpendicularly or whether it branches off in a lateral direction. Researches are also to be made to establish whether the interior of the volcano is a compact mass, or whether there are hollows and subterranean caverns. It is thought that the results of their investigations may

throw light on the phenomena of eruptions and of earthquake shocks."

A CORRESPONDENT of the *Journal* of the American Medical Association writes: "The momentous fact that after extraordinary expansion in the past century the population of England is rapidly approaching a maximum and then an inevitable decline has attracted little notice. The fact that an increase is still going on shuts people's eyes to the fact that the present birth rate is insufficient to maintain the present population in future years. At the congress of the Royal Sanitary Institute, Professor A. M. Carr-Saunders, a statistician, pointed out that the population of this country will cease to increase in 1940, and possibly before then, and will subsequently decline. He said that since the Domesday survey, at the end of the eleventh century, estimates for every succeeding century showed increases interrupted only by temporary catastrophies. It can be proved that the death rate will presently exceed the birth rate, and that the population will begin to decrease without any further decline in the fertility of married women—that is to say, in the size of the family. There is no longer 'a replacement birth rate.' The number of children born within the last five years, who in twenty years should form the 20–25 years age group, does not equal the number now in that group. Moreover, some of them will die before reaching the age of 20. The important point is that the population will cease to increase and will then decline, even if there is no further decrease in the size of the family. But the size of the family decreases every year. If emigration were again to attain its pre-1929 level, a decline would set in before 1940. Emigration on this level from 1929 to 1940 would mean a drop of population by a million at the end of that period. Professor Carr-Saunders complained that there is a complete failure to appreciate the situation. He has seen plans which visualize a population during the next half century arrived at by projecting the continuance of the growth of the last fifty years. In one case a large expenditure has been incurred to supply water for a population that will never exist."

DISCUSSION

JAPAN HONORS CHINA

GOZARIMASU[1] is a magic word which one hears on every hand on arrival in Japan. None of the language books written for tourists or even the recent Japanese-English dictionaries tell the meaning. One learns only that it is polite to say gozarimas*u*.[1] After some study into the Japanese and Chinese languages one learns that "go" is of Chinese origin, the word having been brought from China to Japan after 600 A. D., and the rest of the expression is the form of the verb "arimasu." Since the Japanese have no alphabet but only a syllabary, formed from Chinese grass characters representing individual Chinese words used only for their sound, one realizes that these syllables are often used in place of consonants and a vowel is either very much slurred or entirely silent. This combination of Chinese and Japanese in the language is symbolic of the civilization of Japan. The Japanese have no record of their antiquity, but anthropologists have shown that there is a considerable Malay element. We may picture their forebears as Malay pirates and fishermen settling on the shores of these great islands and conquering and absorbing the aborigines. The process of absorbing the Ainu aborigines is still going on in Hokkaido and Sakhalin (Karafuto). I visited an Ainu chief in Hokkaido. He was living in a Japanese house and had served in the Japanese army. He still preserved the ancient custom, however, of using a mustache lifter, which figured not only in the drinking from a bowl but in the very elaborate grace said at the beginning of the meal. From the Japanese he had adopted the idea of omitting the smoke-hole in the roof. This may have been somewhat forced, however, as Japanese in attacking Ainu villages used to pull straw from the thatched roof, set it afire and poke it down the smoke-hole in order to smoke out the Ainu.

If the Japanese ever lived like Malays they have changed considerably, having adopted chopsticks, lacquer, porcelain, art, printing, silk, tea and rice-culture from the Chinese and moved their houses from stilts in the water onto the shore. The Japanese were not alone in adopting Chinese culture. Europe received from China by way of the silk route through Asia not only silk and tea but the mariner's compass, firearms, printing, alchemy, deep breathing and muscular exercises, for the sake of health, and the medical lore of the pulse. Columbus carried a letter addressed to the Great Kahn when he discovered America and mistook a Mayan ship loaded with textiles for an East Indian vessel. A Japanese told me they had invented their own foot gear, which was peculiar to Japan. However, in the south of Japan they call the sandal "waraji," and the Indians of Mexico make it in the same form and call it "guarachi." These words sound exactly alike, but the spelling of the Japanese follows Reverend Hepburn and that of the Mexican follows the Spanish priests. It is well recog-

[1] *r* and *u* are silent.

nized that the American aborigines came from Asia. Not only was the Behring Strait dry land during the ice age, but within the past year a Russian walked across it on the ice.

If we can gauge human interest in a subject by the time spent on it we must concede that the Japanese are great admirers of Chinese culture. After having employed five thousand foreigners for thirty years to teach them western ways, they still spend the greater part of their school days studying Chinese. If the Japanese ever had any written language of their own they have entirely forgotten it and left no records. Alphabets were carried as far east as Chinese Turkestan by Nestorian missionaries. The people surrounding China proper (Tibetans, Mongolians, Manchurians, Koreans) had alphabets, but the Chinese have taught and have managed to force on eastern Asia the principle that scholarship is inseparable from Chinese characters (ideographs). Japanese were importing Chinese characters from 300 to 600 A. D. At first they used Chinese characters for the sound of the words only. A Chinese word is of only one syllable, and hence these characters formed a syllabary. Some words were vowels, but there were no consonants and the Japanese adopted only one consonant. That was "n." These syllables were at first entirely disorganized, but later made in the form of a poem, and at a still later date arranged in ten columns of five rows each. Chinese characters are not only very difficult to memorize, but are difficult to write and various simplifications were adopted. There developed at least five different printed forms of Chinese grass characters (kana), and the Ministry of Education has reduced them to two (why not to one is a puzzle to all foreigners). Reverend Hepburn, an American missionary to China, was later sent to Japan, where he transcribed Japanese into the Latin alphabet. In this way the kana is transformed into five vowels—a, i, u, e, o—and 42 syllables made of these vowels preceded by k, s, t, n, h, m, y, r and w (Romaji or Romazi).

The Japanese have a very beautiful language and it is rather highly inflected. On the other hand, Chinese has no inflection at all. Chinese has not only no distinction between adjective, adverb, verb and noun, but even when the noun is used as a verb there is nothing to indicate tense, number or person. This may be considered a simplification. For the American boy who has spent years in mastering Latin and Greek, the simplification of language should have a high appeal. English in some respects has been simplified with the years, and we now have Basic English, which is still further simplified. Japanese, however, has taken the opposite course and has been made more complicated, particularly in writing. Whereas the spoken language can be represented in kana, it is not considered scholarly to do so. Chinese writing is the writing of the scholar. The Japanese scholar reads Chinese books by Confucius and Mencius and attempts to use the Chinese characters to represent Japanese thoughts. The newspapers now use about eight to ten thousand Chinese characters. When a character is used as a verb the conjugation is put in small kana, attached to the square Chinese character as a tail onto a kite. But the Japanese wishes to sell his newspapers and for fear that the great masses might not be scholarly, the newspapers are printed with a translation of the Chinese characters in kana between the lines. They resemble in this way the interlinear "ponies" which lazy students used to use in Latin.

In modern times Japanese have introduced compulsory education for the primary school of six years, and enforcement reaches a high percentage. During this time, so far as I could ascertain, they learned only reading and writing, both of Chinese grass characters and square characters. They begin with the simplest form of kana and, after they have learned that, they begin all over again and learn a more complicated form of kana, which is entirely different in appearance. Then Chinese characters are introduced, the first with great caution—that is, one in a lesson, but later more and more frequently, finally coming in great flocks and frightful herds. They have tried to keep the number within a thousand but have not succeeded. We thus witness that the Japanese Empire, whose population now is about 94 million and increasing at the rate of a million a year, spends half a billion years in the study of Chinese, that is to say at least six years for nearly every individual. This outlay of energy appeals to us as enormous, particularly when one considers Chinese foreign. One is strongly tempted to imagine Japan as a part of China—at least a part of the great Chinese civilization.

What will the future bring? Trade and technology have an influence toward the simplification of language (if we exclude trademarks and complicated numbers, which are designed to prevent counterfeit or alteration). The phonograph, radio and "talkie" are making the world smaller in regard to spoken language and may finally obliterate dialects. Basic English may, as a language of international trade, come to be widely distributed. The world may finally adopt the Latin alphabet as Turkey has, but can we even imagine a time when Chinese characters will no longer be used? A Japanese once said that the English used picture writing; for instance, the word locomotive has a smoke-stack in front and wheels beneath. Furthermore, English is no longer completely phonetic in spelling, since the pronunciation has changed with the centuries, and the spelling be-

came fixed after the adoption of printing. With fixed spelling and changing pronunciation English has a point in common with Chinese, in which the character has a fixed form and meaning, but there are many dialects in regard to pronunciation, and although some of these may show a similarity in China, in Japan the spoken word may have no similarity whatever (in fact, there are at least two pronunciations for every Chinese character; one is an ancient Chinese dialect and the other is a Japanese word). Apart from the difficulty of memorizing these characters (there were 80 thousand in one Chinese dictionary) there comes the difficulty of finding them in the dictionary. In the original dialect the root (phonogram) was known as soon as the character was used, since all characters with the same root had the same sound. In Japan the root might be recognized (although it is often so compressed, laterally or vertically, as to be very different in form) but without the knowledge of the pronunciation of the word, finding the root is mere guesswork, since it might be to the right, left, top or bottom. There may be several other parts of the character which might be mistaken for the root. If the root is known, the way to look up the character is by counting the strokes in the root and then looking through that part of the dictionary where word roots have that many strokes. When the root is found, it is necessary to look through all the words with that root to find the one desired. If the root is not known, one must look through the whole dictionary to find the desired word. Though many empirical rules for finding the root have been made they are of little assistance. The difficulty of the Chinese classics has at least once had serious consequences. The leader of the Taiping rebellion was a student who failed in the examinations. It is estimated that 40 million Chinese were killed in the Taiping rebellion.

It is improbable that the use of Chinese characters will ever be entirely lost in the far east. They are cut in hard stone in so many places that they will last at least as long as the stone. A rune stone, left by eight Goths and twenty-two Norwegians in Minnesota in 1362, is still legible, although not taken care of as is Cleopatra's needle.

Perhaps in the very distant future Chinese characters will be chiefly decorative in use. I once attended a gathering of scientists in a Japanese imperial university. There was an inscription on the wall in Chinese characters written by a former president. I inquired among three or four of the professors of the university, but no one could read the inscription. It seemed to be regarded as of decorative value. When one walks down a Chinese or Japanese street one is much impressed by the decorative effect of the long banners covered with Chinese characters in red or some other bright color. This decorative effect is enhanced by variations in their form, which makes them still more difficult to read. On the other hand, the foreigner soon learns the character for ice and some other simple things which appeal to his imagination. It is perhaps this decorative use which will last forever. In regard to the use of the characters to convey information, some simple ones that are used frequently will be retained.

When one reads at the present time the history of China from the beginning of their writing on bamboo sticks, about 2000 B. C., and contemplates that the Chinese empire was a heterogeneous assemblage of different nations and languages, held together only by the common use of Chinese characters among the scholars, one realizes the political effect of making scholarship the road toward political office. This was the one great unifying force in China. What we call China contains many wild mountain tribes entirely untamed and as different from the inhabitants of Canton or Peking as are the Japanese. With the passing of the Empire and the rise of war lords the condition still holds. China is held together by Chinese characters, and with this conception Japan is part of China.

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CYTOGENETIC NOTES ON COTTON AND COTTON RELATIVES

The following chromosome numbers have been recorded in *Gossypium:* (a) Cultivated American species, $n=26$; (b) wild American species (*G. klotzschianum* Anderss., *G. davidsonii* Kellogg, *G. harknessii* Brandeg., *G. armourianum* Kearney), $n=13$; (c) Asiatic species, $n=13$; (d) the Australian *G. sturtii* F.v.M., $n=13$.[1] During meiosis, the interspecific hybrids that have been reported in the literature exhibit: (a) hybrids between cultivated American species, 26 pairs of chromosomes; (b) hybrids between Asiatic species, 13 pairs; (c) hybrids between Asiatic and cultivated American species, 13 pairs and 13 single chromosomes.[2]

In F_1 of interspecific hybrids of *Gossypium* made by the writer and not previously reported, the chromosome complement at the reduction division is composed of: (a) 13 pairs and 13 single chromosomes in hybrids between the cultivated American and the wild American species; (b) from 0 to 4 pairs with from 21 to 39 single chromosomes in hybrids between cultivated American species and *G. sturtii;* (c) 26 single

[1] References cited by J. M. Webber, *Jour. Agr. Res.*, 48: 1934. In press.

[2] References cited by A. Skovsted, *Ann. Bot.*, 47: 227-251, 1933.

chromosomes in hybrids between wild American species and *G. sturtii*. In addition, hybrids between *Thurberia thespesioides* (a plant closely allied to Gossypium), $n=13$, and *G. sturtii* have been found to exhibit 26 single chromosomes at first metaphase.

These new findings indicate that the cultivated American cottons are of allopolyploid[3] rather than of autopolyploid nature.[4]

J. M. WEBBER

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

TOXICITY OF CADMIUM TO CHEWING INSECTS[1]

WHILE testing the insecticidal properties of various phosphates, the writer found that cadmium phosphate possesses appreciable toxicity to silk-moth larvae (the insect generally used in our laboratory for testing stomach poisons). Since none of the other phosphates tested have shown similar properties, the toxicity was at once attributed to the base and tests with other cadmium compounds were started.

Preliminary experiments in the laboratory have revealed that cadmium salts, in general, are toxic to the silk-moth caterpillar. Cadmium oxide and cadmium hydroxide ranked very high in toxicity and compared well with lead arsenate.

Cadmium hydroxide was tested against three different species of chewing insects which were available in the greenhouse, namely, tent caterpillar (*Malacosoma americana* Fabr.), silk-moth caterpillar (*Bombyx mori* Linn.), and confused flour beetle (*Tribolium confusum* Duv.).

Tent caterpillars transferred on apple twigs previously sprayed with cadmium hydroxide in concentrations of 1, 2, 3 and 4 pounds to 100 gallons of water showed percentage kill after 48 hours at the rate of 70, 90, 100 and 100, respectively. Considerable feeding took place during the first day and very little during the last day. About 82 per cent. of the silk-moth larvae were dead two days after they were transferred on mulberry leaves, previously dusted with a mixture of 95 per cent. talc and 5 per cent. cadmium hydroxide. Confused flour beetles placed in flour containing 15 per cent. cadmium hydroxide were found 100 per cent. dead after 10 days of feeding. Similar results were obtained on these insects with spray and dust mixtures containing cadmium oxide. A young apple tree infested with two tent caterpillar nests was sprayed on May 18 with a mixture consisting of 3 pounds $Cd(OH)_2$, 4 pounds lime, 1½ pounds skim milk and 100 gallons of water. Three days later about 90 per cent. of the insects were dead, while the rest appeared sick and were not feeding.

The writer is at present continuing these experiments on insects and is also conducting laboratory and field studies on the effect of cadmium salts on foliage. The results will be published in due time, upon the completion of the experiments.

JOSEPH M. GINSBURG

NEW JERSEY AGRICULTURAL
EXPERIMENT STATION

[3] A. Skovsted, *Jour. Gen.*, 28: 407–424, 1934.

[4] A. E. Longley, *Jour. Agri. Res.*, 46: 217–227, 1933. J. M. Webber, *cf.*, 1934.

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

ON THE INCIDENCE OF COLOR-BLINDNESS AMONG NEGROES

THE incidence of color-blindness in various racial groups recently reported by Garth[1] and by Kilborn and Beh[2] call for this report of observation made on 2,279 Negroes at Hampton Institute, Virginia.

For many years, our physiology students have taken the Holmgren Tests for color blindness, but since such investigators as Clements[3] and Miles[4] found the wool skein tests unsatisfactory, the Holmgren results were not used for this investigation. Instead, our Negro subjects were tested with Ishihara's well-known charts for the detection of color blindness. The subjects were of both sexes and included grade and high-school pupils, college students, teachers and others. Each was tested individually one eye at a time, the chart being placed at eye level at distances of from 24 to 60 inches in good evenly diffused daylight.

Of 1,628 male Negroes tested, 61 or 3.75 per cent. were color blind according to the Ishihara charts. Among these there was one case of monocular blindness, the right eye being red-green blind while the left eye was normal. Among the 651 female Negroes tested, no case of color blindness was observed (0.0 per cent.).

Our results, from a total of 2,279 Negroes, show a C. B. I. (color blindness incidence) of 3.75 per cent. for males (61 cases in 1,628) and agree closely with Garth's report (1933) of 3.9 per cent. for Southern Negroes (21 cases in 538) and almost exactly with Clements' (1930) report on Connecticut Negroes of 3.7 per cent. or 12 cases in 323. Our results of 0.0 per cent. C. B. I. for 651 Negro females agree tolerably well with Garth's 0.8 per cent. (4 cases in 496 Southern Negroes) and 0.0 per cent. or no cases in 165 Northern Negroes, probably in Colorado.

KENNETH B. M. CROOKS

HAMPTON INSTITUTE

[1] "The Incidence of Color Blindness among Races," SCIENCE, 77: 333–4, 1933.

[2] "The Incidence of Color-Blindness among the Chinese," SCIENCE, 79: 34, 1934.

[3] "Comparative Racial Differences in Color Blindness," SCIENCE, 72: 203–4, 1930.

[4] "One Hundred Cases of Color Blindness Detected with the Ishihara Test," *Jour. Gen. Psychol.*, 2: 535–543, 1929.

SCIENTIFIC BOOKS

THE MYXOMYCETES

The Myxomycetes. By THOMAS H. MACBRIDE and G. W. MARTIN. The Macmillan Company. Pp. 1–339, 21 plates. 1934.

THE publication of "The Myxomycetes" and the death of Dr. T. H. MacBride in March, 1934, close a record of publications upon a single group, which has continued over forty years. To an American mycologist, any time in those forty years, the sight of a Myxomycete automatically suggested Dr. MacBride. It is to be hoped that his junior author may carry on for a similar period.

The authors define the class Myxomycetes, as "characterized by an assimilative phase consisting of a naked, multinucleate, mobile mass of protoplasm, the plasmodium, and a reproductive phase, consisting in most cases of a membranous spore case." They include in the Class Myxomycetes two subclasses, the Exosporeae with the single genus Ceratiomyxa and the Myxogastres or Endosporeae with about four hundred species whose fruit bodies are among the curious and beautiful growths to be found in the forest. After a historical résumé of discovery and nomenclature, including the controversy as to their plant or animal nature, they conclude that "their actual study has been left almost entirely to the botanists," whose rulings as to nomenclature within the group are accepted and applied in this volume.

They exclude the Acrasieae, the Plasmodiophoraceae, the Labyrinthuleae and the Hydromyxales. This disposes of the forms so microscopic as to baffle the discriminating collector in the field. The book, then, covers the group well known to the botanist in the field, in the laboratory, and in the herbarium as Myxomycetes, or to the zoologist as Mycetozoa.

About 375 accepted species are distributed into sixty genera, of which 34 are monotypic. The large genera are carefully "keyed." The index gives page references to about 1,450 specific names arranged alphabetically under the generic names. A specific name with a checkered generic record is sometimes hard to find. A separate list of about 400 additional names is given in the appendix, of which only a few are assigned as synonyms. Citations of place of publication for this list do not appear, hence many of them would be difficult to verify. Even the authority cited for a specific name in certain cases does not appear in the "Bibliography."

One new species, *Badhamia gracilis* MacBride, appears on page 35, and one new name, *Physarum listeri* MacBride, for *P. luteo-album* Lister, appears on page 62. They drop two generic names used in MacBride's 1922 edition of "The North American Slime Moulds," and introduce thirteen generic names not recognized there.

The entire history of the group, together with the controversies, the advances in the study of the physiology and cytology, and the information for collection and preservation of specimens, totals fourteen pages. Pages 15 to 306 are devoted to classification and description. Twenty-one plates carrying 573 figures complete the book. The plates, as in MacBride's previous books, lose much of definiteness by appearing as half-tones instead of line drawings, but they add much to the utility of the text.

Theories as to cell and nuclear constitution are reviewed, with the conclusion that spores germinate into flagellate swarm cells which eventually become nonmotile, divide and resume the flagellate form. Rapid multiplication is thus provided for, but eventually the swarm cells fuse in pairs and the zygotes so formed develop into the plasmodia. The data discussed are cytological and morphological—*i.e.*, descriptive, rather than physiological.

Unfortunately, the whole function of the group in nature is dismissed with the note that they "are of no direct economic importance." Reference to their vegetative habits is prefaced by the word "probably." They thus remain in this, as in previous manuals, as curiosities of the herbarium whose claim is limited to the form and beauty of their fruit bodies.

One looks in vain for adequate designation of the habitat of most species; the forest or the wood-lot seems to have been assumed for all of them. "Locality" may be Europe, Texas, Japan, Iowa—which is not very definite assistance to the collector. There was, perhaps, a time when such generalization was excusable. To-day with the mounting demand for information as to the part played by any microorganism in the economy of nature on the one hand, and with the demand for simple assistance to the collector on the other, it would seem that the authors should have given us more tangible information where possible.

The flaws noted only emphasize the size of the task accomplished. Every worker in the field will welcome a book which brings the descriptive literature of this group into a critically arranged manual. Such a book makes identification possible to the worker who can not command all the necessary journals in half a dozen languages, or obtain the mass of reprints that carry the new species and genera described since

MacBride published his second edition of the "North American Slime Moulds" in 1922.

CHARLES THOM

BUREAU OF CHEMISTRY AND SOILS
U. S. DEPARTMENT OF AGRICULTURE

EMERGENT EVOLUTION

The Universe and Life. By H. S. JENNINGS. Yale University Press, New Haven. Pp. 1–94. $1.50. 1933.

THE deed of gift of the Dwight Harrington Terry Foundation, in paraphrase, seeks the construction of a broadened and purified religion in the application to human welfare of scientific and philosophical truths as they become available. The criterion by which any endeavor originated on this foundation must be judged therefore is its aptness for integration into the defined pattern. What contribution have biological experience and philosophy, as interpreted by the zoologist, to make in our practical application of the known facts of evolutionary progress to the management of life. Professor Jennings set himself this theme and he treats it as a problem in emergent evolution governed by the principle of trial and error. We should of course expect the author to approach his subject from this angle and we search hopefully through the pages for evidence of a constructive practical philosophy to crown the author's long and valiant struggle against the mechanistic interpretation of biology. Is modern scientific specialization the most appropriate training for such a purpose? One need not invoke the doctrine of predestination to induce a zest for living, but its substitution by trial and error affords no thrill. The materials for living, thanks to chemistry and physics, are far more familiar to the public than the fabric of life. Hence a biological philosophy requires greater elaboration and illustration to make it fit within the reader's experience. Professor Jennings takes this course, though apparently biology must await the accumulation of much new knowledge before it can construct even a pattern to set before us, let alone a lodestone to keep at our side.

In the plain impressive words of Marcus Aurelius "the universe is either a confusion and a dispersion, or it is unity, order and providence." The reviewer believes that biosocial applications essential to the fulness of modern life may burst the doors of the laboratory from without, insistently thundering for attention.

T. WINGATE TODD

WESTERN RESERVE UNIVERSITY

SOCIETIES AND MEETINGS

THE TWELFTH INTERNATIONAL VETERINARY CONGRESS

COMING to the United States for the first time in the 71 years since its organization, the International Veterinary Congress held its twelfth session from August 13 to 18, 1934, at the Waldorf-Astoria Hotel, New York City. The congress received official government sanction through the opening address of welcome by Hon. M. L. Wilson, Assistant Secretary of Agriculture, in addition to the designated patronage of President Franklin D. Roosevelt and the vice-patronage of the Secretary of Agriculture, Henry A. Wallace. The object of the conference previously had been sanctioned by the State Department.

Convening for the purpose of reporting scientific progress throughout the world in veterinary science and allied technical fields, the delegates presented and discussed papers in general and sectional meetings throughout the week. The program included the following general topics:

Pathology, bacteriology and contagious diseases.
Medicine, surgery and obstetrics.
Fowl diseases.
Combating enzootic diseases under a state veterinary service.
Relationship of veterinary science to animal breeding and public health. Legal protection of practises of veterinary science.
Veterinary parasitology and parasitic diseases.
Tropical diseases.
Animal breeding and dietetics.
Veterinary control of marketing of milk.
New researches on filterable viruses.
New researches on contagious abortion.
Hygiene of meat and milk.

The foregoing topics were discussed in 81 scientific papers which subsequently will be published in the proceedings of the congress. In view of the international character of the gathering, summaries of the papers had previously been printed in four languages—English, French, German and Spanish—and were distributed to members of the congress as a basis for discussion.

To attempt in this brief account a résumé of the various papers reporting the results of new research and developments in the regulatory field would be so sketchy as to do a scientific injustice to the papers. Suffice it to say that they dealt with new and improved methods for protecting live stock of the world from a wide range of diseases and conditions which tend to reduce the value of such animals to mankind and

which also, in some cases, are transmissible directly or indirectly to man.

International Good Will Is Sought

Though primarily a scientific gathering, the Twelfth International Veterinary Congress was flavored with a universal desire among the delegates to promote world-wide good will and improved international relations. It was pointed out that accurate technical knowledge is necessary for wise administrative action and that the results of scientific study are a material aid in bringing about economic stability and safety for man as well as for his animals.

Supplementary features of the congress included especially arranged radio broadcasts on August 14 and 16 over a network of about 60 stations in the United States, with a pick-up by 3 short-wave stations which provided far-reaching international distribution. The radio addresses dealt largely with the constructive purposes of the congress and the desire to improve the safety of animal production through prevention and control of diseases and parasites.

Additional features of the congress were educational and commercial exhibits, daily showings of motion pictures, a trip to the Rockefeller Institute near Princeton, N. J., to the Walker-Gordon Farm at Plainsboro, N. J., and to local milk-handling and pasteurizing plants. There were also a surgical clinic and post-congress tours to government laboratories and experimental farms at Washington, D. C., Ottawa and Montreal, Canada, the stockyards and meat-packing establishments of Chicago, and other points of scientific, industrial or scenic interest. Special programs were arranged also for the ladies present.

The total attendance at the sessions of the congress in New York was approximately 1,850 delegates. In addition, about 1,350 veterinarians and allied scientific workers who were unable to attend forwarded their registration by mail or through delegates, making a total registration of approximately 3,200. Thirty-seven foreign countries or colonial possessions were represented by 164 delegates from abroad, all these members being present. The world-wide character of representation was apparent by the presence of delegates from Norway and Canada to South Africa and Australia. All important live-stock countries of the globe were represented.

Resolutions on Wide Range of Topics

The deliberation of the congress resulted in a series of 9 resolutions. Those of scientific import dealt with the following topics: Further scientific study and administrative procedures for the prevention and eradication of tuberculosis; intensified international study of lymphadenitis of sheep; greater consideration of diseases affecting young animals; appointment of a permanent international committee on control of parasites and parasitic diseases; greater attention to diseases of poultry; increased study of genetics in relation to veterinary science; improved organization and facilities for the international exchange of veterinary knowledge, and veterinary supervision of milk supplies.

At its closing session, the congress voted to hold its next meeting in Switzerland in August, 1938. Details of arrangements will be announced later.

John R. Mohler,
President of the Congress

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MELTING POINT APPARATUS FOR MINUTE SAMPLES[1]

In a study of the volatile constituents of tomato and cactus fruits, it was found that the yield of certain crystalline derivatives was insufficient even to make an ordinary melting point determination on them. Under ideal conditions the observations of the melting point of individual crystals by means of a microscope will allow of the identification of a millionth of a gram or less of material. Mixtures of crystals can also be detected. The sublimation temperature of certain crystals and the appearance of the condensed sublimate are additional properties that may be used to check the identity of a crystal.

A variety of micro melting point or hot-stage instruments have been described.[2,3,4,5] Chamot and Mason[6] give a good discussion concerning the desiderata of such instruments. Köfler[7] discusses the practical applications of the instruments in the identification of crystals.

The apparatus, shown in the illustration, was devised after a number of trials and may be obtained from H. S. Kern, of Ann Arbor. It has been in use in this laboratory for more than a year and has given satisfactory results.

[1] Paper No. 498 of the Botany Department, University of Michigan.

[2] Cram, *Jour. Am. Chem. Soc.*, 34: 954, 1912.

[3] Köfler and Dernbach, *Arch. der Pharmazie*, 269: 104, 1931.

[4] R. Kempf, "Methoden der Organischen Chemie," J. Houben, Vol. 1, 1925.

[5] G. Klein, *Mikrochemie*, Pregl Festschrift, 1929.

[6] Chamot and Mason, "Handbook of Chemical Microscopy," Vol. 1, John Wiley and Son, 1930.

[7] L. Köfler, *Arch. der Pharmazie*, 270: 293, 1932.

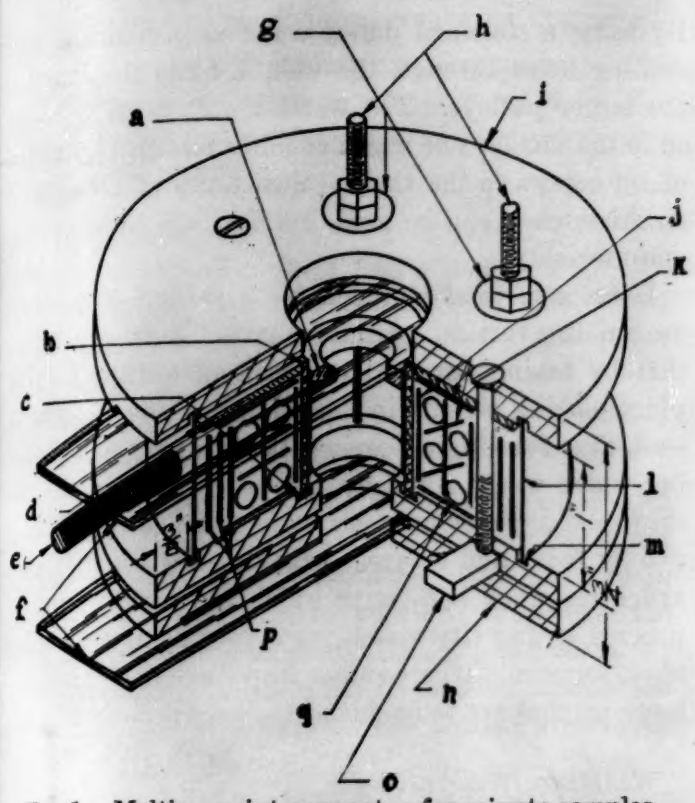

FIG. 1. Melting point apparatus for minute samples.
a—Tripod, made by press fitting three $\frac{1}{8}$" steel pins into a brass ring $\frac{7}{8}$" diam.
A thin $\frac{5}{8}$" disk of glass, which supports the crystals, is placed upon the tripod.
b—Copper tube $1\frac{1}{8}$" long, 1" diam., set in
c—a groove, and flanged and pressed at the top into
d—a brass disk 2" diam.
e—Thermometer.
f—Ordinary microscope slides.
g—Brass washers.
h—Brass binding posts.
i—Transite top $\frac{1}{4}$" × $3\frac{3}{4}$" with 1" hole drilled at the center.
j—Mica insulation.
k—Brass bolts.
l—Nickeled iron, 21 gauge, set in
m—a groove in the transite.
n—Base of two $\frac{1}{4}$" × $3\frac{3}{4}$" layers of transite riveted together with a $\frac{5}{8}$" hole at the center of the base.
o—Brass strip 1" set into transite base.
p—Sheet asbestos.
q—Heating element—110V, 1.25 amp., formed by winding 15 ft. of 30 gauge chromel wire on a 5/32 in. rod.
All space around the insulation and heating element, filled with fireproof cement. This apparatus was connected in parallel with a 50, a 75, and a 100 watt light bulb which were used to vary the amount of current passing into the apparatus.

The instrument is inexpensive and easily constructed. It is essentially a short copper tube wound with chromel resistance wire as the heating element and insulated on the top and bottom with transite. The heat is concentrated around the copper tube, thus decreasing greatly the heat lag from the heating element to the center of the copper tube. The upper and lower windows of the tube are snug-fitting glass slides which can be moved horizontally in and out of the transite insulation. This arrangement, therefore, permits of a shifting of the upper glass window when the field of vision becomes befogged by steam or sublimate. The crystals are placed on a thin coverslip which rests upon a brass tripod. The coverslip is close enough to the upper glass slide to permit the use of a 16 mm objective. Because of the arrangement of the heating element, the instrument may be placed on an ordinary microscope without fear of injury to its hard rubber stage. A rheostat, or simply a number of lamps in parallel, connected to a 110 volt A.C. line, will permit easy regulation of the temperature up to 300° C. The instrument has a low heat lag and therefore heats rapidly and cools rapidly. This is of advantage in shortening the period of observation.

The reading of the thermometer is not that of the melting point of the crystals except below 100° C. A calibration curve is constructed for the thermometer, using pure crystals of known melting point. The approximate melting point of the unknown crystal is first determined. A crystal of known melting point is selected in this immediate melting point range, and placed on the same coverslip with the unknown. The melting points of both are then observed simultaneously.

There is no advantage in using a thermocouple in place of a thermometer. A thermocouple arrangement, as Linser[8] has shown, requires that the apparatus be heated up in exactly the same manner each time, otherwise the heat lag of the apparatus will produce a considerable error in the reading. The reading can therefore only be an approximation of the true melting point.

Professor F. G. Gustafson has given his kind suggestions and advice in connection with planning the apparatus.

SAM GRANICK
UNIVERSITY OF MICHIGAN

LABORATORY STIRRERS

I HAD occasion to do some research work on clay plastics at one time and had to rig up a set of agitators in a hurry. The general arrangement is as shown in Fig. 1. A small grinding motor was used for power, though almost any sort of motor would do. I procured a ten-foot length of $\frac{1}{2}$-inch steel rod to use for a shaft. I found out that the bearings, pulley and collars could be obtained as parts of the home workshop sets found in hardware and department stores. These fittings are all for $\frac{1}{2}$-inch shaft. Small lengths of shafting can also be obtained at these places. I needed a longer shaft and picked it up at a machine shop. I had four agitators connected up at one time. The speed could be regulated by using different-sized pulleys on the top of the vertical shafts of the agitator. Ordinary grooved pulleys were used with a round leather belt. It is unusually hard to find pulleys in the store of much more than 6 inches

[8] H. Linser, *Mikrochemie*, 9: 253, 1931.

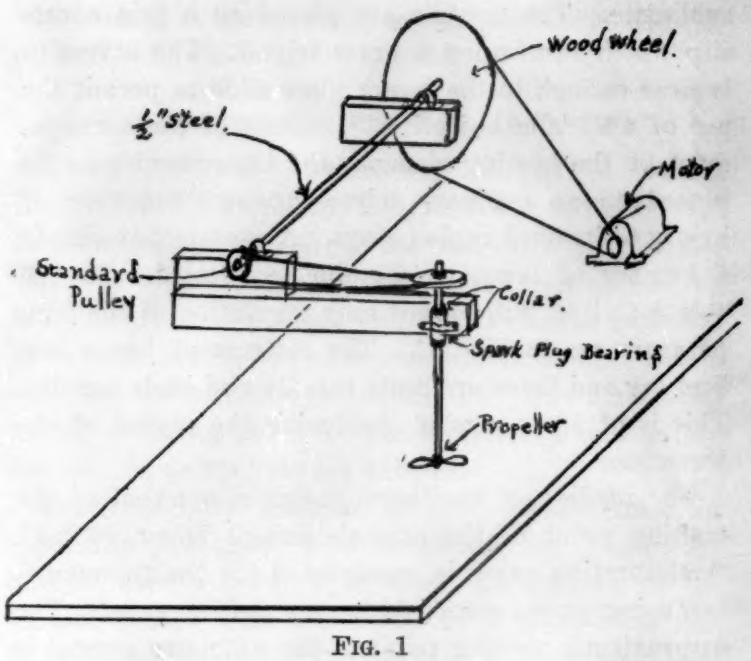

FIG. 1

in diameter. I had some turned out of wood of 12- and 16-inch diameter with a groove along the edge. By using a standard pulley 4 inches in diameter and drilling holes through the web, I made the hub for the larger pulleys. The wooden pulleys were bolted on to the smaller one which could be clamped by means of set screws to the shaft. Sometimes an old sewing machine wheel can be used, but they are rather heavy and unwieldy.

I was somewhat stumped for a vertical bearing to use on the vertical agitator shafts. I finally found that by taking out the center of an ordinary spark plug, placing a shaft in it and then filling it up with lead, thus forming a bearing, I had a very good bearing which would stand up for quite some time. The shaft and agitator bearings were fastened to ordinary two by fours and securely braced. The use of standard home workshop parts which are usually easy to procure in any city makes for a very flexible arrangement, especially where rather heavy materials in fairly large batches are to be mixed for long periods of time.

K. B. HUMPHREY

WATERLOO, WIS.

SPECIAL ARTICLES

THE BIOLOGICAL EFFECTS OF THYMUS EXTRACT (HANSON)[1]

FOLLOWING the continuous administration of thymus extract to successive generations of parents, marked acceleration in the rate of growth and development has been observed during the early life of the offspring, particularly of the third and later generations. Thus the rate of development encountered in the fifth generation of young rats born of four generations of thymus-treated forebears is almost beyond belief.

A small colony of white rats was secured from the Wistar Institute on June 16, 1933. These were divided into test and control groups. The test animals have been subjected to date to intraperitoneal injection of 1 cc of thymus extract (Hanson) daily, even during the periods of pregnancy and lactation. Litter mates born to these rats have been mated in pairs and these have likewise been so treated and the effects on parents and on the offspring noted. Thus original test animals of the first generation (F_0) have undergone continuous treatment since June 16, 1933; the F_1 generation since September 10, 1933; the F_2 generation since September 25, 1933; the F_3 generation since January 19, 1934; and the F_4 generation since April 15, 1934. In the young treatment has usually been begun from the 16th to the 20th day after birth in the prepubertal group and from the 40th to the 60th day in the mature group.

The extract used in these experiments was prepared by Hanson[2] in 1930 briefly as follows: The thymi from 2 to 6 weeks old calves were extracted in 0.5 per cent. HCl solution with the aid of heat. This extraction differs from the extraction from parathyroids by Hanson simply in the degree of acidity used in its preparation. This preparation is extremely stable and is entirely potent and satisfactory for injection in rats even after being kept at room temperature from 2½ to 4 years. The extract was golden yellow in color and resembled bouillon in taste and smell. It has a pH of about 5.0 and is non-toxic in relatively large doses and non-irritating locally on injection.

In summarizing the results of treatment in the second generation (F_1), it might be said that treatment of the parents with thymus extract (Hanson) apparently results in an increased number of litters, an increase in the size of the litters, an increased birth weight and a decreased infant mortality compared with our controls. In later litters born to such parents, evidences of precocity appear, *i.e.*, increased birth weight, earlier eruption of the teeth, appearance of fur, opening of the eyes, descent of the testes and opening of the vagina.

The accruing precocity in successive generations of rats of the third, fourth and fifth generations is shown in the accompanying table.

[1] From the Philadelphia Institute for Medical Research (the Samuel Bell, Jr., Laboratory) in the Philadelphia General Hospital, the Laboratories of the Philadelphia General Hospital, Philadelphia, Pennsylvania, and the Hanson Research Laboratory, Faribault, Minnesota. With the technical assistance of Arthur Steinberg, B.S.

[2] *Jour. American Medical Association*, 94: 653, 1930.

THYMUS-TREATED RATS CONTRASTED WITH CONTROLS

	Controls	F_1	F_2	F_3	F_4
Average birth weight in gms	4.6	5.0	5.2	5.7	5.7
Ears opened (days)	2½–4	2	1–2	1	1
Teeth erupted (days)	9–10	4.7	1–2	1	1
Hair appeared (days)	14–17	10–14	4–6	4–5	3
Eyes opened (days)	14–17	12–15	4–6	4–5	3
Testes descended (days)	35–40	15–29	5–9	4–6	4–5
Vagina opened (days)	60–70	35–45	23–31	21–25	18–19

Weight curves of rats under the influence of thymus extract reveal a markedly accruing acceleration in the third, fourth and fifth generations. This is shown in the accompanying figure in which C represents the controls, F_1 the second generation, F_2 the third, F_3 the fourth and F_4 the fifth generation under the effects of excess of thymus. The shaded areas rep-

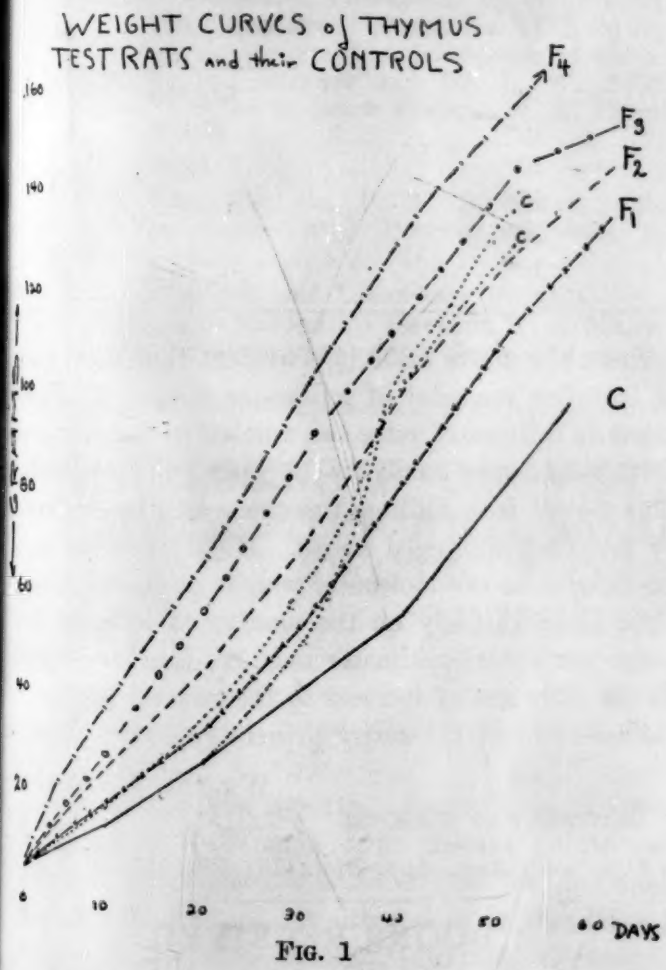

FIG. 1

resent the growth curve of more than 2,000 Wistar rats between October 7, 1933, and January 30, 1934. A study of these curves indicates that treated animals of the third, fourth and fifth generations at all times from the fourth to the fortieth day weighed more than double the control rats and at all times up to thirty days of age outweighed the rats of the Wistar Institute. Between the third and the twentieth day our fifth generation rats exceeded the Wistar rats in weight by more than 100 per cent. After the sixtieth day these curves tend to come together, so that eventually the test animals are not perceptibly larger than the controls. Giants do not result. Thymus effects concern primarily early growth and development.

The psychical precocity is as striking as the physical in the thymus-treated strain of rats. Thus fifth generation (F_4) test animals appear almost as capable and alert as normal rats of 16 to 20 days of age. Weaning is possible at 3 days of age. Animals weaned as early as the third day have fared as well or better than their litter mates left with their parents.

The thymus treated animals appear to be healthy, contented and docile. Their actions, asleep or awake, resemble those of normal controls in every way. They do not resent the needle to any great extent, apparently suffering no pain or distress following the injection of thymus extract.

Thymus extract administered to the parents accelerates the rate of growth and development in the young. The normal relation of growth and development to time is disturbed and precocity results. Accruing acceleration in growth and development is encountered in succeeding generations born to thymus-treated parents. The results with the thymus extract have led us to adopt the same procedure in the study of other hormones and glandular products with the idea of amplifying evidence of their effects.

L. G. ROWNTREE
J. H. CLARK
A. M. HANSON

ISOLATION OF THE INFECTIVE PRINCIPLE OF VIRUS DISEASES

A NUMBER of attempts have been made to concentrate the infective principle of virus diseases, particularly of tobacco mosaic. Considerable success has been attained in these efforts and the results are of great interest. If the virus is non-living the isolation of the virus as a definite chemical compound might be anticipated as the end result of such efforts. Without attempting a discussion of the living or non-living character of the causative agents of virus diseases, the following calculations are of interest in relation to the isolation of the infective principle.

Assume the molecular weight of the infective principle to be 100,000; then 100,000 grams of pure infective principle will contain 6.06×10^{23} molecules and one molecule will weigh $10^{-18} \times \frac{1}{6.06}$ grams. Assume the number of infective particles per cubic centimeter of juice to be 1,000,000; then one cubic centimeter of juice will contain $10^{-12} \times \frac{1}{6.06}$ grams of infective material. To secure 0.1 gram of pure infective material,

assuming 100 per cent. yield, it would be necessary to begin with $0.1 \div 10^{-12} \times \frac{1}{6.06}$, or 606,000,000 liters of juice.

In making such a calculation it should be emphasized that the figures used for the molecular weight of the infective principle and for the number of infective particles per cubic centimeter are assumptions.

Little definite evidence is at hand as to the size of the infective particles in virus diseases. Duggar and Karrer[1] concluded on the basis of filtration experiments that the infective particles of tobacco mosaic approximate those of fresh 1 per cent. hemoglobin solution, which would indicate a diameter of around 30 millimicrons. Waugh and Vinson[2] state that preliminary experiments show the radius of the infective particle of tobacco mosaic in purified preparations to be less than 5 millimicrons. MacClement and Smith[3] recently report diameters of 15 millimicrons for tobacco and yellow mosaic viruses, 40 to 50 millimicrons for aucuba mosaic and 150 millimicrons for *Hyoscyamus* virus. If these figures represent the particle size of the infective agent of tobacco mosaic and the molecular weights usually given for proteins are employed, a molecular weight of the order of 100,000 for the virus of tobacco mosaic does not seem an unreasonable assumption.

The number of infective particles per cubic centimeter is not known and it is probably impossible with the data at hand even to approximate it. Allard[4] inoculated young tobacco plants by puncturing every leaf of any size, usually four or five, in several places with a needle dipped in the infective juice. Diluting the juice 1,000 times with tap water had no effect on its infectiousness; at a dilution of 1 to 10,000 some attenuation was found; and at a dilution of 1 to 1,000,000 infection was rare. Assuming that a successful inoculation represents an infective particle and the amount of juice introduced by the needle prick is 0.0001 cubic centimeter, we might estimate the number of infective particles at 10,000 per cubic centimeter in the juice diluted 10,000 times or at 100,000,000 per cubic centimeter in the undiluted juice. Geoffrey[5] using a glass spatula, rubbed leaves with infected juice. He secured as many as 283 local lesions per leaf with juice diluted 1 to 10,000. Assuming that each lesion represents an infective particle and 0.01 cubic centimeter of juice was used on each leaf, this would mean 283,000,000 particles per cubic centimeter. On the basis of the number of local lesions formed on *N. glutinosa*, Caldwell[6] has calculated the concentration of the virus of aucuba mosaic to be 3×10^7 particles per cubic centimeter.

The following table shows how great the number of infective particles must be per cubic centimeter of juice if an infective principle of molecular weight of the order of 100,000 can be isolated from reasonable quantities of juice. Assuming a molecular weight of 100,000, the varying number of infective particles per cubic centimeter in the table given below would require the quantities of juice indicated, to yield one tenth gram of infective material, if no loss of the principle occurs during isolation.

Number of infective particles per cubic centimeter of juice	Quantity of juice necessary to yield 0.1 gm of infective material of molecular weight of 100,000
10^6	606,000,000 liters
10^7	60,600,000
10^8	6,060,000
10^9	606,000
10^{10}	60,600
10^{11}	6,060
10^{12}	606
10^{13}	60
10^{14}	6

From the above table it is evident that if 0.1 gram of infective material of molecular weight of 100,000 exists in 6 liters of juice the number of infective particles would necessarily be 10^{14} per cubic centimeter. This figure is a million times the number indicated by the work discussed above. Highly speculative as the figures on the molecular weight of the virus principle and especially on the number of infective particles per cubic centimeter may be, the figures given in the table are of interest to the general problem of the isolation of the active principle of virus diseases.

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[1] Duggar and Karrer, *Ann. Missouri Bot. Garden*, 8: 343, 1921.
[2] Waugh and Vinson, *Phytopath.*, 22: 29, 1932.
[3] MacClement and Smith, *Nature*, 130: 129, 1932.
[4] Allard, *Jour. Agr. Res.*, 3: 295, 1915.
[5] Geoffrey, *Ann. App. Biol.*, 18: 494, 1931.
[6] Caldwell, *Ann. App. Biol.*, 20: 100, 1933.

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